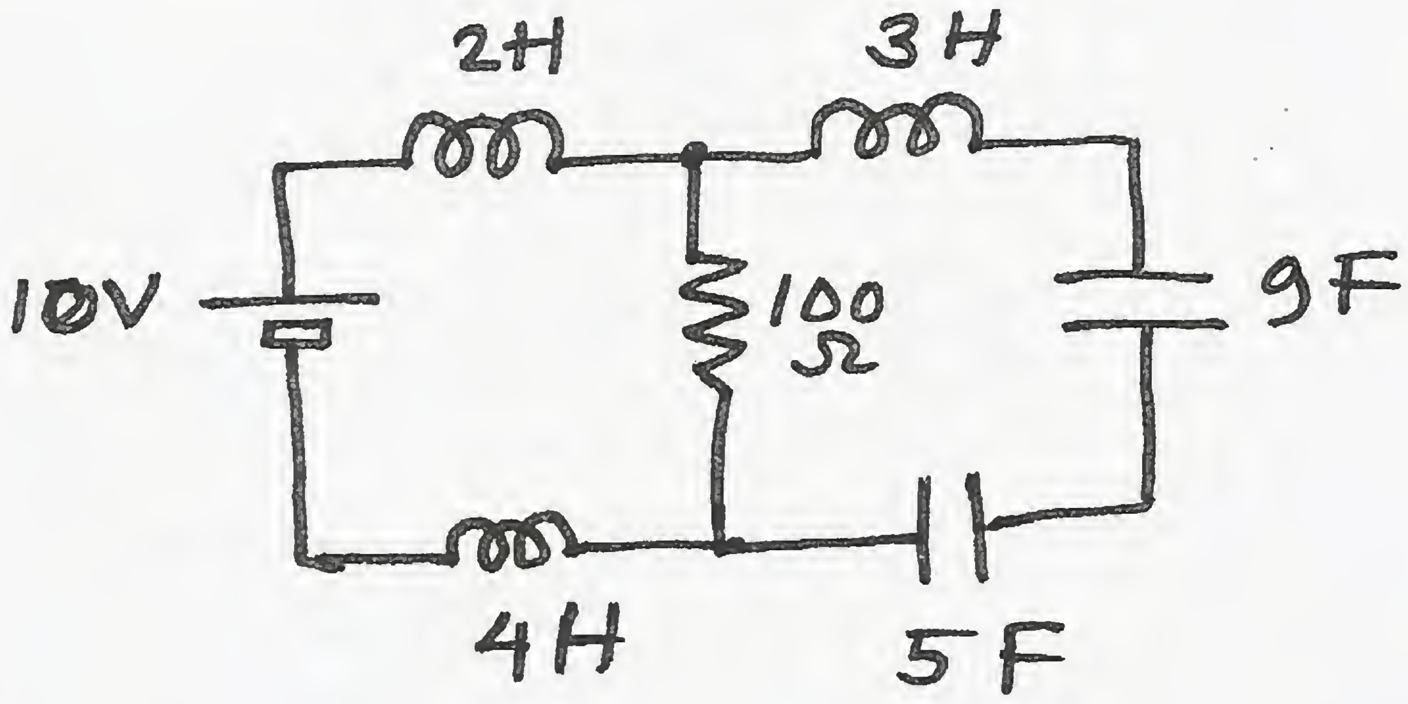
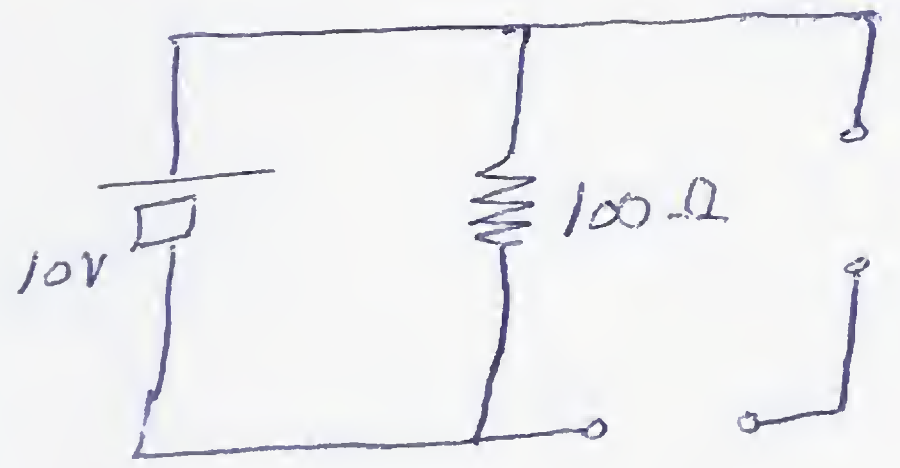
Q1. In the following circuit, find the steady state energy stored in each element (R, L, C):



At the steady state :



$V_{100\Omega} = 10\ V$

$I_{100\Omega} = \frac{V}{R} = \frac{10}{100} = 0.1\ A$

$I_{2H} = I_{4H} = I_{100\Omega} = 0.1 A$

$\therefore \mathcal{E}_{2H} = \frac{1}{2} L i^2 = \frac{1}{2}(2)(0.1)^2$

$= 0.01\ J$

$\mathcal{E}_{4H} = \frac{1}{2}(4)(0.1)^2 = 0.02\ J$

$I_{3H} = 0\ A$, $\therefore \mathcal{E}_{3H} = 0\ J$

$C_{9F+5F} = \frac{9 \times 5}{9+5} = \frac{45}{14}\ F$

or C_{eq}

$\therefore V_{C_{eq}} = V_{100\Omega} = 10\ V$

$\therefore \mathcal{E}_{C_{eq}} = \frac{1}{2}\left(\frac{45}{14}\right)(10)^2 = \frac{1125}{7}\ J$

$q = CV \Rightarrow q_{eq} = \frac{45}{14}(10) = \frac{225}{7}\ C$

$V = \frac{q}{C}$

$V_{9F} = \frac{\frac{225}{7}}{9} = \frac{25}{7}\ V$

$\therefore \mathcal{E}_{9F} = \frac{1}{2}(9)\left(\frac{25}{7}\right)^2 = 44.6429\ J$

$\mathcal{E}_{5F} = \frac{1}{2}(5)\left(\frac{\frac{225}{7}}{5}\right)^2 = 103.3163\ J$

$\mathcal{E}_{100\Omega} = 0\ J$

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Q2. In the following circuit, the switch was left open for a long time then closed at time $t = 0$.

Find v_x

1. At $t = 0$
2. At $t = \infty$
3. At $t = 3s$

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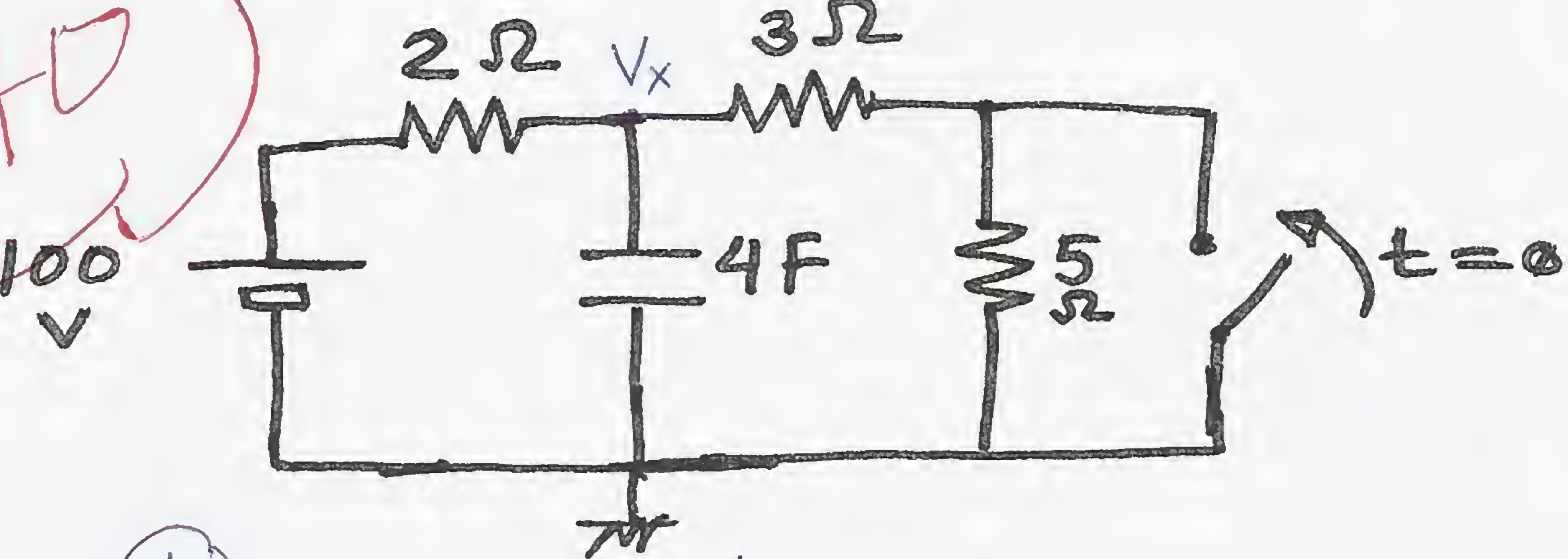
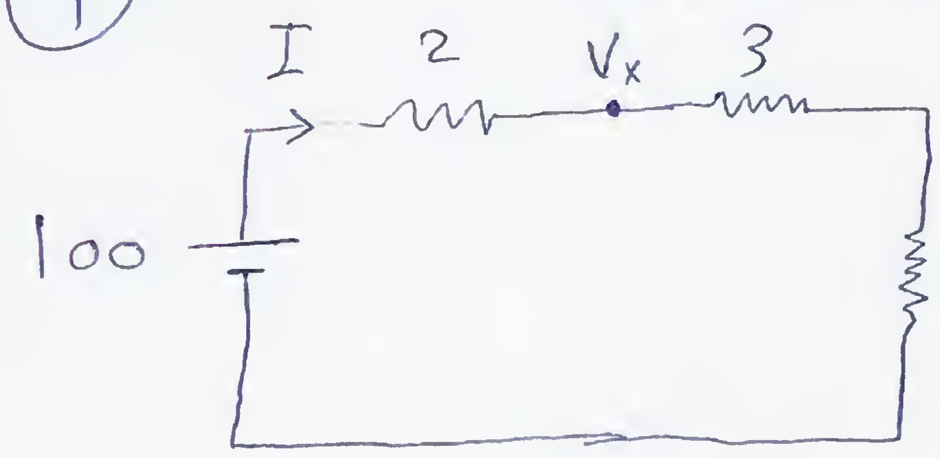


~~Steady state:~~

(1) Steady state

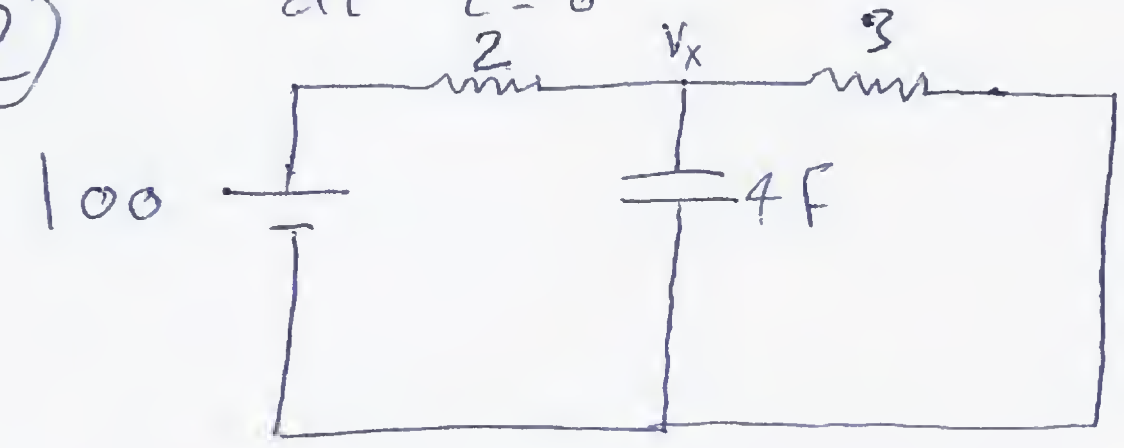


$$I = \frac{V}{R} = \frac{100}{2+3+5} = \frac{100}{10} = 10\ A$$

$$V_0 = V_x = 100 - 2(I) = 100 - 2(10)$$

$$V_0 = V_x = 100 - 20 = 80 \text{ volt}$$

(2) at $t = 0$



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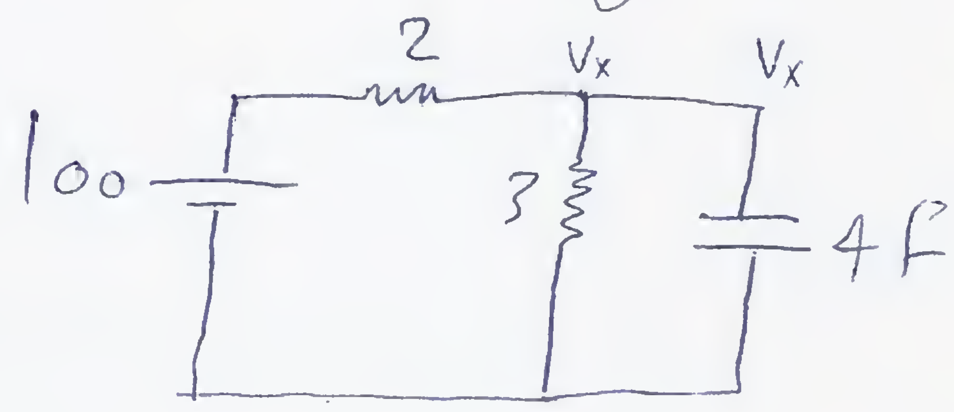
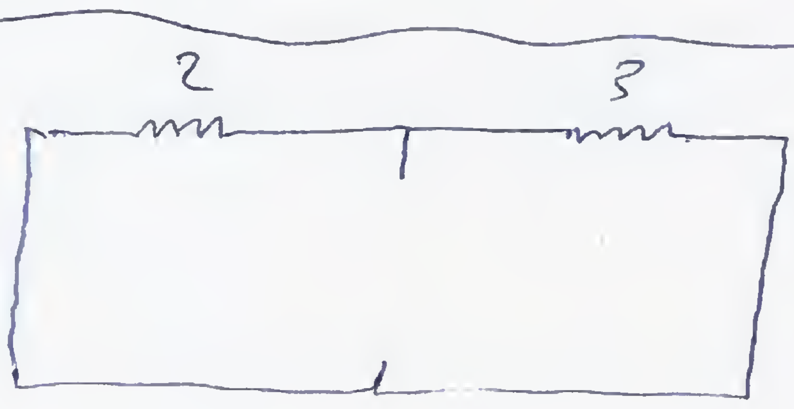


$$V_x = \frac{100 \times 3}{3+2} = \frac{300}{5} = 60 \text{ volt} = V_\infty$$

(3)



$$R = 2 \parallel 3 = \frac{2 \times 3}{2+3} = \frac{6}{5} = 1.2\ \Omega$$

$$RC = (1.2)(4) = 4.8 \text{ sec}$$

(4)

$$V_c = V_\infty + (V_0 - V_\infty) e^{-t/RC}$$

$$V_c = 60 + (80 - 60) e^{-t/4.8}$$

$$V_c = 60 + 20 e^{-t/4.8}$$

at $t = 0$

$$V_c = 60 + 20 e^{-\frac{0}{4.8}}$$

$$V_c = 60 + 20 e^{0}$$

$$V_c = 60 + 20 = 80 \text{ volt}$$

at $t = \infty$

$$V_c = 60 + 20 e^{-\infty/4.8}$$

$$V_c = 60 + 0$$

$$V_c = 60 \text{ volt}$$

at $t = 3$

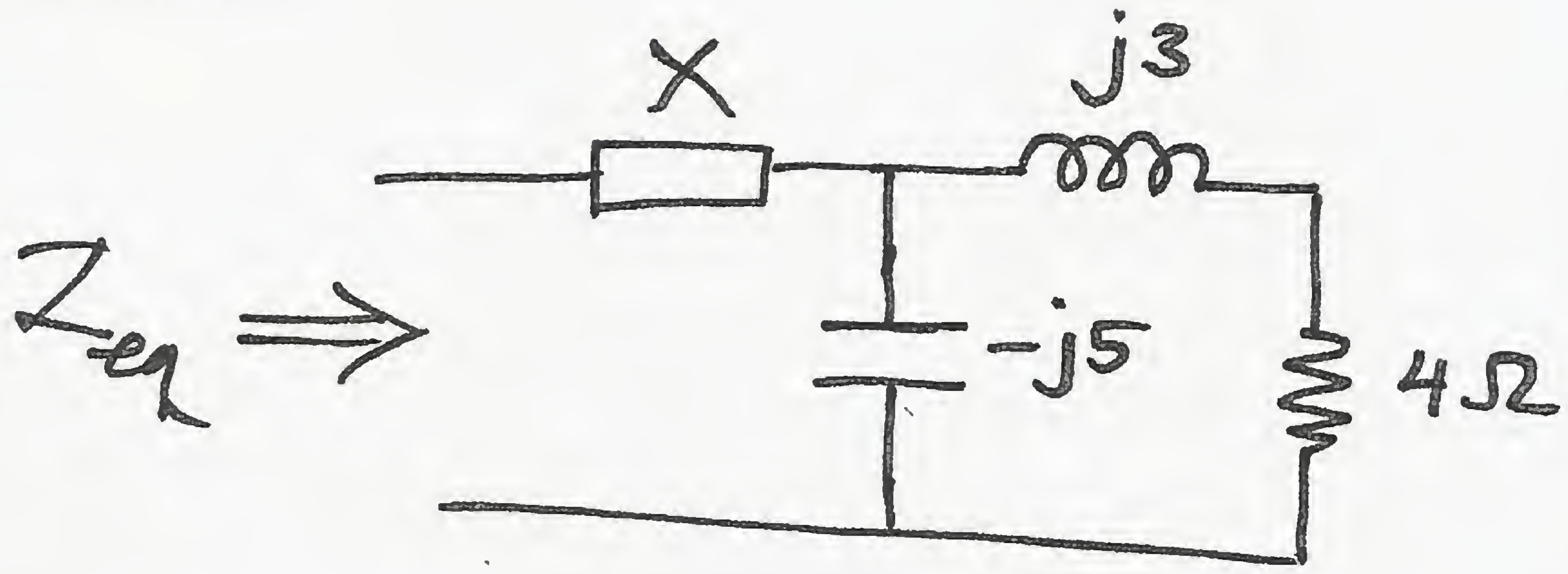
$$V_c = 60 + 20 e^{-3/4.8}$$

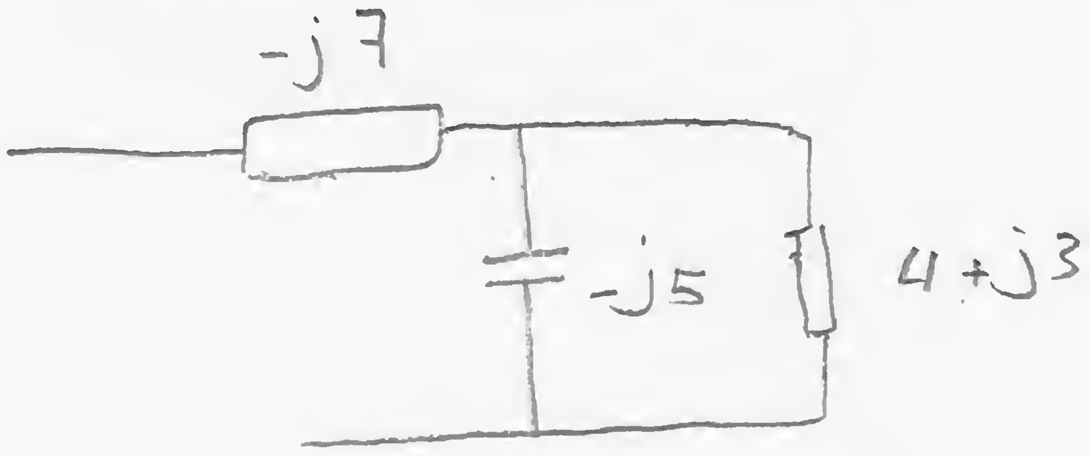
$$= 60 + (20)(0.54)$$

$$= 70.8 \text{ volt}$$

Q3. In the following circuit:

1. Find **Zeq** if **X = -j7**
2. What value of **X** will make **Zeq** pure resistive?





$\boxed{1}$ $j3 + 4\Omega \Rightarrow 4 + j3$

$\boxed{2}$ $-j5 \,//\, 4 + j3$

$\Rightarrow \frac{1}{eq} = \frac{1}{-j5} + \frac{1}{4+j3}$

5 - 2.5 i

$\frac{1}{eq} = \frac{4}{25} + \frac{2}{25} j$

$eq = 5 - j2.5$

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$Z_{eq} = 5 - j2.5 + (-j7)$

$= 5 - j9.5$

Z_{eq} will be pure resistive when $X =$

$5 = 5 - j2.5 + X$

$X = j2.5$